

Special PITTCON '92 I

February 1992

A Cahners Publication

# R&D

Research & Development

## INFRARED IMAGING

Uses From Missiles to Medicine

Page 46

### ANALYTICAL CHEMISTRY

**SFE Quickly Releases  
Stubborn Compounds**

Page 78

### CAREER SURVEY

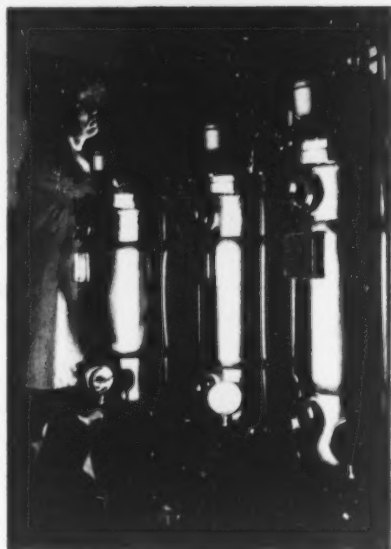
**Do You Like Your Job?**

Page 72

### GLOBAL TECHNOLOGY

**Eastern Europe Beckons**

Page 58



Producing antibody fragments, page 25

# R&D

The International Magazine of Research and Development

## FEATURES

### SPECTROSCOPY

**IR Images Track Heat Sources To Make Things Smarter** 46

### R&D MANAGEMENT

**East Europe's R&D** 58

### BIOTECHNOLOGY

**Antisense RNA Keeps Tomatoes Green** 64

### R&D SURVEY

**Satisfaction Stumbles in Tough Economy** 72

### ANALYTICAL CHEMISTRY

**SFE Provides Quick Release Of Stubborn Compounds** 78

### MICROSCOPY

**Revealing the Beauty of Small Worlds** 84

### LABORATORY EQUIPMENT

**Autosamplers Do Much More Than Take Samples** 90

### ENVIRONMENTAL RESEARCH

**New Waste-Destruction Method Takes Aim at World's Sludge** 98

### LABORATORY SUPPLIES

**10 Good Reasons To Break The Glassware Habit** 115

### VACUUM TECHNOLOGY

**How Small Can Devices Get?** 123



IR Imaging, page 46

## DEPARTMENTS

|                                                                 |     |
|-----------------------------------------------------------------|-----|
| IN BRIEF                                                        | 5   |
| EDITORIAL                                                       | 15  |
| BUSINESS                                                        | 19  |
| NEWS                                                            | 24  |
| INDUSTRY EVENTS                                                 | 37  |
| BOOK REVIEWS                                                    | 38  |
| INNOVATIVE NOTEBOOK                                             | 43  |
| PITTCO '92<br>POCKET GUIDE                                      | 103 |
| A pullout guide listing the exhibitor booths at the conference. |     |
| MANAGEMENT                                                      | 131 |
| NEW PRODUCTS                                                    | 134 |
| PRODUCT CENTER                                                  | 165 |
| LITERATURE                                                      | 169 |
| SOFTWARE                                                        | 183 |
| ADVERTISERS INDEX                                               | 188 |
| TRENDLETTER                                                     | 190 |
| READER SERVICE CARD                                             | 191 |

**ABOUT THE COVER** IR imaging allows Spectra-Physics Inc. to optimize design and quality control of its Brewster window, a critical laser component. Photo: AGEMA Infrared Systems Inc.

# R&D BUSINESS

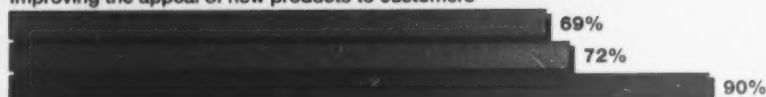
## Study Reveals Views on Product Innovation

### Product Innovation Goals Differ

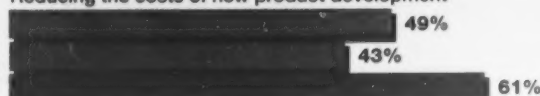
Getting new products to the market on time



Improving the appeal of new products to customers



Reducing the costs of new product development



Respondents indicating they were devoting a high level of effort

Source: Arthur D. Little Inc. ■ U.S. ■ Europe ■ Japan

Few respondents to a product innovation study indicated their efforts were low in any area; however, Japanese respondents indicated the highest levels.

There are strong regional variations in how corporate managers view their product innovation efforts, according to a recent study by Arthur D. Little Inc., Cambridge, MA.

"Japanese managers are devoting more effort to more areas of product innovation than either U.S. or European companies who responded to the survey," says Ranganath Nayak, a senior vice president at Arthur D. Little and leader of the study. "Japanese companies have concentrated on understanding the product innovation process for a long time."

More than 700 respondents contributed to the study, 50% from Europe, 40% from the U.S., and 10% from Japan. Some of the response differences could be attributed to the way Japanese managers reply to a question, says Nayak. Japanese managers "take a broader, more systematic view of the product innovation process, and are more willing to take bold steps to improve their products rather than rely on small incremental improvements."

The management systems that the different regional companies put in place also are different. "A Mazda

plant in Mexico, for example, has less automation and fewer workers than U.S. automotive plants," says Nayak. "The management system put in by the Japanese allows the plant to be run by the average person, whereas U.S. or European companies often try to put in 'superman' managers."

This was reflected in the study where U.S. and European managers rated the lack of skilled leaders as their greatest barriers to product innovation. Japanese managers pointed to "poorly communicated objectives for new products and insufficient attention to product specifications" as their greatest barriers to innovation.

U.S. and European companies need to put in more structured procedures to match Japanese companies' competitiveness, says Nayak. For a copy, 617/864-5770. —Tim Studt

## In Recession, Focus On Core Units

Decentralizing and downsizing are common actions that many companies will take during a recession. Forward-thinking companies should restructure to improve their competitive position when the economy improves, not just to reduce costs, says Thomas Boyce, a consultant for SRI International, an R&D consulting firm in Menlo Park, CA.

Less than half of the firms that restructure to reduce costs, increase their competitive advantage, or take advantage of technical advances actually achieve their goals, according to recent studies.

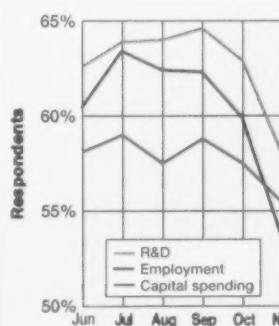
Business continues

## Users Switching to Hyphenated GC



The U.S. market for hyphenated gas chromatography (GC) systems is growing at an annual rate of 14%, according to a study by Strategic Directions Intl., a Los Angeles-based consulting firm. Dominating this market are sales of GC-MS instruments, which account for more than 80% of the total. GC-FTIR and GC-AES account for the remainder.

Lower prices and environmental regulations are driving this market.



## R&D Confidence Slows

The recession continued to erode managers' confidence in their ability to maintain R&D efforts, capital spending, and employment levels, according to a survey by Cahners Economics, Newton, MA.

In December, only 56% of the respondents said they would maintain or increase operations over the next few months.

## IRSD BUSINESS

"In technical-intensive industries, the ability to share value-adding technical activities and transfer proprietary skills across business units can provide a competitive advantage, even in a decentralized environment," says Boyce.

"New technically complex projects, acquisitions, or alliances will be more attractive if they draw on existing core competencies or contribute to building new ones," he says.

Advancing the state of the art is inherently risky, with the result that products and process improvements are often late or miss the cost and performance target of users.

Boyce recommends that sharing information across business units is one way to more effectively monitor projects, core technologies, and successfully model project data. □

## Fewer Engineers Graduate in U.S.

For the fifth year in a row, fewer people in the U.S. received BS degrees in engineering than in the previous year, according to a recent survey of 1991 graduates by the Washington-based American Assn. of Engineering Societies.

Since the peak year of 1986, the number of engineering graduates has declined 18.2% to 63,986 in 1991. During this same period, however, the number of engineers receiving MS degrees increased 20.5% to 27,754, and those receiving PhD degrees increased 54.1% to 5,680.

The total number of engineers has declined in all categories since 1986, except in aerospace, biomedical, and ceramic areas. The biggest category—electrical and electronic engineering—declined 19% from 24,514 BS graduates in 1986 to 19,858 in 1991.

A decline in the number of college-age students and less interest in engineering have been reported as the main reasons for these decreases. While the number of women receiving BS degrees declined from 1986 to 1991, the drop was not as rapid as the overall total, thus increasing women's share of the total. The number of minority BS graduates actually increased slightly to 15,958, thereby increasing their share to nearly 25% of the total. □

## Europeans Buy More Foreign Equipment

European semiconductor manufacturers often favor foreign production equipment even when the technology is available in their home market, says Willem Maris, managing director of ASM Lithography, Veldhoven, Netherlands.

"European manufacturers suffer under a mentality of being behind the times in technology," he says. "The assumption seems to be that if they were to catch up, they should look to the U.S. or Japan for their production equipment, especially in the critical wafer fabrication area."

Maris believes that the European equipment manufacturers are gaining respect in global markets faster than they are in Europe. The EC's Strategic Programme for R&D in Information Technology (ESPRIT) is helping to support European manufacturers' development efforts. □

## DOC Forecasts Modest Increase in Instruments

Shipments of laboratory instruments and apparatus will grow 4.5% in constant dollar value in 1992 to \$13.86 billion, according to the U.S. Dept. of Commerce's *U.S. Industrial Outlook—1992*.

Moderate expansion of the economy and growth in pharmaceutical, food processing, advanced materials, and biotechnology fields will continue to drive an annual 4% in real growth through 1996.

While domestic demand accounts for most of the expected growth, exports of analytical instruments will continue to provide a significant share of sales, says Maguerite Nealon, an analyst at the DOC's Office of Microelectronics and Instrumentation. However, foreign competition may dampen some of this growth in overseas markets.

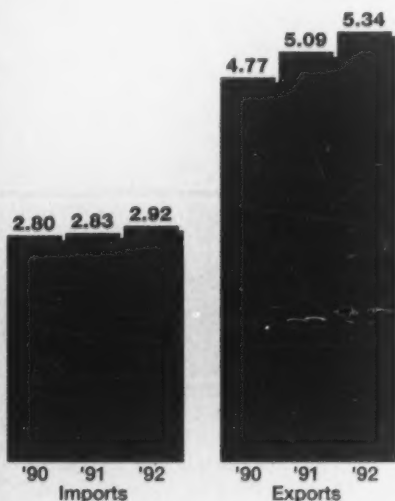
European Community countries are the largest export market for U.S. laboratory instrument manufacturers, being the destination of about a third of total exports. Canada and Mexico are the next largest export markets (17%), followed by Japan (14%), and newly industrialized countries (NICs) in East Asia (15%).

The largest sources of imports are Japan (37%), EC countries (35%), and East Asia NICs (8%).

Analytical instruments have experienced the strongest growth in the laboratory instrument and apparatus group, says Nealon. This market grew by 6% in 1991 to \$4.99 billion.

In the same category, the DOC also forecasts shipments of measuring and controlling instruments to increase by 4.5% in 1992 to \$11 billion. Here, too, exports will exceed imports by almost a two to one ratio.

## Positive U.S. Trade Balance Forecast in Instruments (in billions of dollars)



Source: U.S. Dept. of Commerce

*U.S. manufacturers consistently export almost twice the value of laboratory instruments as is imported.*

## Next Production Goal Is Total Integration

Development of integrated systems that replace today's fragmented approaches to production is the primary goal of most manufacturing managers, according to Alphonse Vitale, project director of the Automation & Productivity Institute, Stow, MA.

Vitale illustrates how different classes of advanced technologies can be combined to create new production techniques in his *Forecast of Manufacturing Technologies for the '90s*. "Manufacturing managers need to be aware of what technologies are likely to become available over the next several years," he says.

"Combining massively parallel computing methods with new vision and sensing technologies, for example, will significantly increase the number of axes that can be coordinated in future robotic systems," he says. For a copy (\$395), 508/897-1075.

R&D

## Job Satisfaction Slips

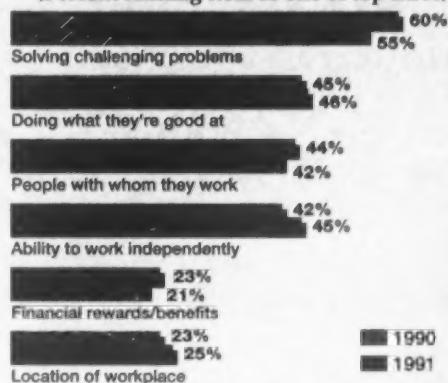


Source: 1990 and 1991 Career Satisfaction Surveys

The percentage of researchers who were very satisfied with their jobs in 1991 fell from the previous year, while the percentage of dissatisfied researchers rose. Satisfied researchers in 1991 included 75% of those in consulting, 67% in universities, 60% in industry, and 51% in government.

## Researchers' Most Satisfying Job Aspects

(Percent ranking item as one of top three)



Source: 1990 and 1991 Career Satisfaction Surveys

In 1991, problem-solving was at the top of the list for researchers in consulting, industry, and government. The ability to work independently was first for university researchers.

## R&D SURVEY

# Satisfaction Stumbles In Tough Economy

R&D's survey data show a little drop in career satisfaction—but respondents' comments convey a lot of worry.

By John Morkes, Associate Editor,  
R&D Magazine

Last year was a tough one for U.S. researchers, many of whom faced budget cuts, lost their jobs, or felt increased pressure to perform with fewer available resources.

In this difficult environment, researchers' job satisfaction slipped, according to the 1,209 scientists and engineers who responded to R&D Magazine's Career Satisfaction Survey, which was conducted in the spring of 1991.

At that time, 60% of the respondents said they were satisfied with their positions, compared with 64% in 1990 (see chart). Included in these figures were those who were "very satisfied": 18% in 1990 and only 8% in 1991.

In 1991, the survey shows, 75% of researchers in consulting were satisfied, as were 67% in universities, 60% in industry, and 51% in government.

"It's nice working for a company whose products are the best in the market and so well recognized," said one satisfied chemist.

Despite the fact that the majority of respondents were satisfied, the ma-

jority of their comments focused on the negative.

Many worried about the poor state of the economy and resulting staff reductions.

"Repeated reductions in the Defense portion of my corporation have trimmed the workforce by 25% in three years. And there's no end in sight," said an electrical engineer.

"Our company is operating under Chapter 11. Capital is tight, and employees have been laid off. It used to be a great place to work!" said a chemist.

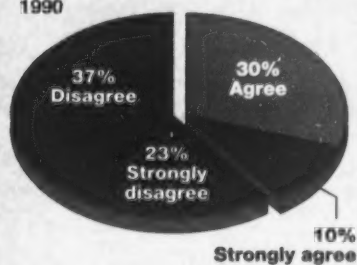
"My company's new owners have held layoffs, taken away benefits, reduced morale, and generally destroyed what was once a great corporation. We hope the economy recovers before they close the place or we all lose our jobs through layoffs. They are exploiting the lack of jobs by tightening the screws on us each day. Our managers have been reduced to rear-end-covering cowards afraid to speak their minds or fight for their employees," complained an electro-optics researcher.



## Communication Breakdown

"My employer effectively communicates organizational goals to me."

1990



1991



Source: 1990 and 1991 Career Satisfaction Surveys

**Workers in government** (66%) complained the most about a lack of communication in 1991, followed by those in industry (56%), universities (51%), and consulting (42%). Overall, 56% saw a communication problem.

## Feeling Left Out

"My employer involves the R&D department in corporate strategy."



**Most researchers in government** (63%) felt left out of strategy, as did 59% in industry, 53% in universities, and 52% in consulting.

Nearly a third (31%) of the respondents said they had less job security than a year before (see chart), though 15% had more job security. For 54%, the level stayed about the same.

"We were nearly axed but proved our value to the corporation. Our group's future has never been more secure," said an industrial chemist.

Researchers expressed concern about U.S. competitiveness problems, which they said have a great impact on career satisfaction. The respondents offered opinions about the problems' sources.

"American industry is extremely

wasteful of material, intellect, and energy. How do we survive?" asked an industrial chemist.

"Big Business's MBAs are destroying U.S. competitiveness," said an industrial materials researcher.

"R&D is still smothered by bureaucracy. U.S. business continues to suffer for it," said an industrial chemist.

"Between the budget deficit and corporate views of research, the U.S. will quickly become third rate," said an industrial biomedical researcher.

A majority of researchers (58%) felt that their departments were left out of corporate strategy (see chart). Many

complained of their employers' failure to back long-term projects.

"Long-term research is now defined as six months or less. R&D is getting jerked around by Marketing again," said an industrial chemist.

"The inability of the corporation to set long-term product development strategies is often frustrating," said a mechanical engineer.

Other respondents said their bosses cared more about quick profits than research.

"R&D is not valued as an asset in today's business environment; it is treated as a cost center," said a chemical engineer.

"I thought academia was full of anal-compulsive bottom-liners; industry is even worse!" said a pharmaceuticals researcher.

As in 1990, "too much bureaucracy" was the most common gripe from respondents (54%). Government employees (81%) felt the most bogged down by bureaucracy, followed by those in industry (49%), universities (46%), and consulting (31%).

For many researchers, duties such as paperwork and fund raising, which keep them from work in the lab, were worthy of complaint.

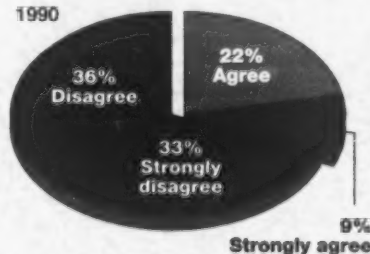
"Too much time is spent on accounting, reporting, and proposal writing. Talented people face too many barriers to spending time in the lab," said an industrial chemist.

"The main disadvantage of my job

## Rewards and Opportunities

"My employer offers researchers the same rewards and opportunities to advance that it offers managers."

1990



1991

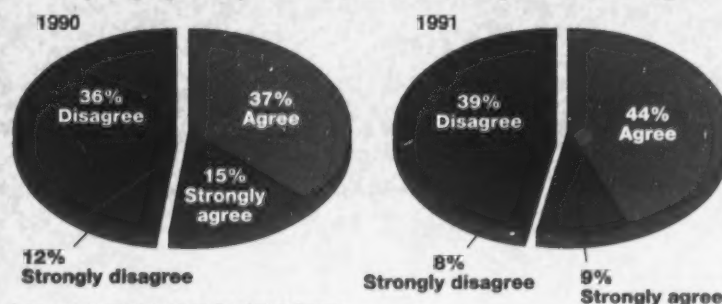


Source: 1990 and 1991 Career Satisfaction Surveys

**Only 30% of the respondents** said scientists and engineers received the same advancement opportunities as their organizations' managers in 1991. More women (77%) saw a difference in advancement opportunities than men (69%).

## New Ideas and Independent Thinking

"My employer is open to new ideas and independent thinking."

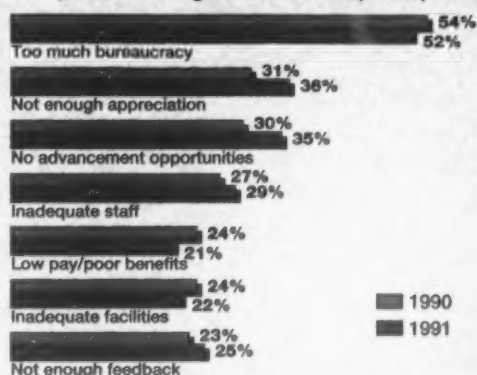


Source: 1990 and 1991 Career Satisfaction Surveys

Employers were open to new ideas in 1991, said 53% of the respondents. University researchers (65%) gave their employers high marks, followed by those in consulting (64%), industry (52%), and government (45%). Government employers received the lowest marks from 14% of their workers.

## Researchers' Least Satisfying Job Aspects

(Percent ranking item as one of top three)



Source: 1990 and 1991 Career Satisfaction Surveys

In 1991, government scientists and engineers (81%) felt the most bogged down by bureaucracy, followed by those in industry (49%), universities (46%), and consulting (31%).

"'Total disgust' characterizes my opinion of my employer. Know anyone who needs a chemist?" said one researcher.

is having to beg, scrounge, and fight for funds. There is a constant battle for money. That is demoralizing and takes more time than the research," said a government ecologist.

"Not enough appreciation," cited by 36% of all respondents, was the second most common complaint. Industry researchers (38%) led the pack, followed by government (33%), uni-

versities (32%), and consulting (31%).

"No advancement opportunities" was the third least satisfying job aspect for all researchers (35%). It was cited by 37% in industry, 31% in government, 29% in consulting, and 26% in universities.

"Management has you by the short hairs, knowing there are few jobs out there these days. It makes advancement difficult," said an industrial mechanical engineer.

Overall, researchers' top three most satisfying job aspects were "solving challenging problems" (cited by 55%), "doing what I'm good at" (46%), and "the ability to work independently" (45%).

"Solving challenging problems" was the aspect cited most by researchers in consulting (74%), industry (56%), and government (49%). For 66% of university researchers, "the ability to work independently" was first.

Some respondents said that freedom was one of their most satisfying job aspects.

"Working in a nonprofit environment with the freedom to do what is needed is heaven compared to bottom-line corporations," said an industrial engineer who develops products for the blind.

Managers received much criticism from respondents. One problem area was communication: 56% of the respondents said their employers did

not effectively communicate organizational goals (see chart).

"Communication of company goals, especially long-term R&D goals, is poor. The corporate hierarchy is too distinct, inhibiting communication between levels," said an industrial mechanical engineer who serves as a project director.

Other criticisms of management were less specific.

"Managers have little common sense," said a government computers researcher.

"There are plenty of managers, but no leaders," said a government electrical engineer.

For some who were less than very satisfied with their careers, management was to blame.

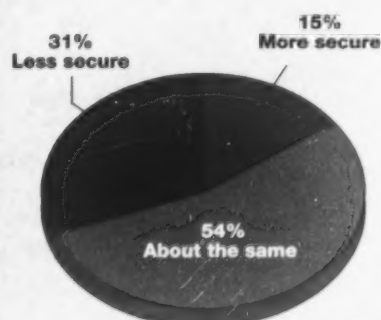
"'Total disgust' characterizes my opinion of my present employer. Know anyone who needs a chemist?" said one researcher.

Other researchers were more philosophical about career satisfaction.

"I reached my lifetime goal, yet I am not satisfied," said a chemical engineer. "It may be the nature of scientists never to be satisfied." R&D

## How Researchers Rate Job Security

(Compared with previous year)



In consulting, 21% of the researchers felt they had more job security, compared with 15% in both industry and universities, and 11% in government.

## READER RESPONSE PANEL

Please rate your interest in this article by circling the appropriate number on the Reader Service Card.

High 464 Medium 465 Low 466

|                                      | Page No. | Circle No. |
|--------------------------------------|----------|------------|
| Melles Griot                         | 160      | 147        |
| Meridian Laboratory                  | 155      | 125        |
| Metrohm Ltd.                         | 97       | 62         |
| Mettler Instrument Corp.             | 33       | 27         |
|                                      | 152      | 120        |
| Meyer Tool & Mfg., Inc.              | 181      | 196        |
| Micromeritics Instrument Corp.       | 184      | 200        |
| Microstar Laboratories               | 151      | 116        |
| Mikron Instrument Co., Inc.          | 162      | 141        |
| National Electrostatics Corp.        | 149      | 113        |
| National Instruments                 | BC       | 210        |
| Neslab Instruments Inc.              | 95       | 60         |
| New Focus, Inc.                      | 29       | 23         |
| Newport Corporation                  | 41       | 211-213    |
| Newport Electronics                  | 3        | 2          |
| The J.M. Nev Co.,                    |          |            |
| Neytech Div.                         | 172      | 172, 173   |
| Nicolet Analytical Instruments       | 77       | 36         |
| Nikon Inc., Instrument Group         | 23       | 20         |
| Nor-Cal Products, Inc.               | 122      | 71         |
| Olympus Corporation                  | 81       | 50         |
| Omley Industries                     | 157      | 130        |
| Osmonics Inc.                        | 176      | 182        |
| Oxford Instruments, Inc.             | 31       | 25         |
| PE Nelson                            | 37       |            |
| Pacific Northwest Laboratory         | 165      | 150        |
| Park Scientific Instruments          | 174      | 178, 179   |
| Parr Instrument Co.                  | 185      | 201        |
| Perkin-Elmer Corp.                   | 4        | 3, 4       |
|                                      | 8-9      | 6, 7       |
| Petrolab Corporation                 | 178      | 188        |
| Philips                              | 36       | 29         |
| Physica USA                          | 166      | 154        |
| Polycold Systems, Inc.               | 159      | 135        |
| Polyscience Corporation              | 178      | 187        |
| Princeton Gamma-Tech, Inc.           | 155      | 126        |
| Quatech                              | 139      | 88         |
| Remcor Products Co.                  | 173      | 175        |
| Research Software Design             | 142      | 96         |
| Rexham Industrial                    | 144      | 102        |
| Rodenstock                           | 166      | 156        |
| Rolyn Optics                         | 167      | 162        |
| STN International                    | 40       | 33         |
| STSC, Inc.                           | 13       | 32         |
| Sartorius Instruments                | 67-70    | 100        |
| Scientific Specialties Service, Inc. | 177      | 183        |
| Scotsman Buildings                   | 143      | 98         |
| Soft Shell International Ltd.        | 154      | 123        |
| Soft Warehouse, Inc.                 | 32       | 26         |
| Sony Communication Products Co.      | 75       | 47         |
| Spectra Physics                      | 45       | 214-217    |
| Spectra-Source, Inc.                 | 182      | 197        |
| Spectra-Tech, Inc.                   | 176      | 181        |
| Stanford Research Systems            | 14       | 13         |
| Stat-Ease Inc.                       | 149      | 111        |
| Statistical Sciences, Inc.           | 171      | 168        |
| Stephens Equipment Inc.              | 144      | 103        |
| Surcom Associates, Inc.              | 167      | 159        |
| Swagelok Company                     | 18       | 16         |
| SynChrom                             | 158      | 133        |
| Technical Instrument Co.             | 154      | 122        |
| Technical Manufacturing Corp.        | 166      | 155        |
| Techware Systems Corp.               | 163      | 145        |
| Teledyne Hastings-Raydist            | 185      | 202        |
| Tencor Instruments                   | 127      | 76         |
| Tescom Corporation                   | 175      | 180        |
| Thermionics Laboratory Inc.          | 125      | 73         |
| Trek                                 | 157      | 131        |
| Tremetrics, Inc.                     | 148      | 109, 110   |
| Turner Instruments, Div. of Unipath  | 129      | 78         |
| Tuthill Pump Company of California   | 28       | 22         |
| US Inc.                              | 150      | 114        |
| Ulvac Sinku-Riko, Inc.               | 142      | 95         |
| Valco Instruments Co., Inc.          | 119      | 68         |
| Varian Associates                    | 27       | 21         |
| Varian, Vacuum Products              | 17       | 15         |
| VAT, Inc.                            | 42       | 35         |
| Velmet, Inc.                         | 126      | 74         |
| Viscotek Corp.                       | 151      | 117        |
| Visual Research Corp.                | 167      | 158        |
| Walker Scientific Inc.               | 152      | 119        |
| J.A. Woollam Co.                     | 172      | 171        |
| Zircar Products, Inc.                | 161      | 139        |

**R&D** (ISSN 0746-9179) (GST #123397457), formerly *Research & Development*, is published monthly except semimonthly in February by The Cahners Publishing Company (Subscription includes all issues). Cahners Publishing Company is a Division of Reed Publishing USA, 275 Washington St., Newton, MA 02158-1630. Terrence M. McDermott, President/Chief Operating Officer; Frank J. Sibley, Executive Vice President; Charles E. Moodie, Senior Vice President/General Manager; Chicago Division: Jerry D. Neth, Senior Vice President/Publishing Operations; J.J. Walsh, Senior Vice President/Finance; Thomas I. Dellamaria, Senior Vice President/Production and Manufacturing; Ralph Krupp, Vice President/Human Resources; Donald C. Knapp, Vice President/Publisher.

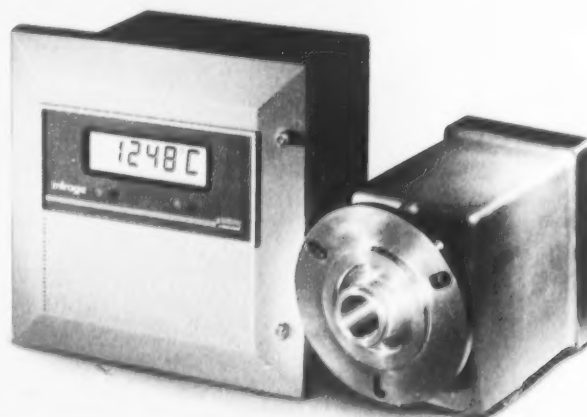
**Circulation records** are maintained at Cahners Publishing Company, 44 Cook St., Denver, CO 80206-5800. Phone: 303/388-4511. **Circulation:** More than 111,104 copies distributed. Second-class postage paid at Denver, CO 80206-5800, and at additional mailing offices. **Postmaster:** Send address corrections to *R&D Magazine*, P.O. Box 173377, Denver, CO 80217-3377. *R&D Magazine* copyright 1992 by Reed Publishing USA, Robert E. Krakoff, Chairman and Chief Executive Officer.

**Subscription rates** for nonqualified people: USA, 1 yr \$59.95, 2 yr \$104.95; Canada, 1 yr \$101.60, 2 yr \$203.25 (Canadian rates include 7% goods and services tax); Mexico, 1 yr \$94.95, 2 yr \$189.95, all other countries, 1 yr \$114.95, 2 yr \$214.95, air mail surcharge, 1 yr \$65, 2 yr \$130. Single copies are available for \$15. Product Source is available for \$50. Address all subscription mail to *R&D Magazine*, 44 Cook St., Denver, CO 80206-5800. Include zip code and, for change of address, copy of old label.

**Research & Development** is a registered trademark of Reed Properties Inc., used under license. All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or by any information storage retrieval system, without written permission of the copyright owner.

ABP ▽ BPA

## Performance, reliability, flexibility and outstanding value



### ... only with IRCON MIRAGE®

#### The most cost-effective infrared thermometer with truly world-class features.

The IRCON MIRAGE is designed to set a new standard of performance using a compact, reliable signal processing unit.

It also offers a choice of six high-performance sensors and these powerful features:

- IEC-348 and NEMA-12K international specification standards, including an FM intrinsically safe version
- Operation within discrete temperature ranges from 0°F to 6500°F (0°C to 3500°C)

- 1% accuracy, 0.3% repeatability of full scale temperature
- Focusable or fixed focus sensor series for viewing targets as small as 0.012" (0.3 mm)
- Simple adjustment for emissivity and response times
- Peak-picker and two point On/Off control options
- Highly visible LCD display

#### Let the IRCON MIRAGE respond to your application.

For more information, or to arrange for a Free demonstration, call us at 1-800-323-7660 (U.S. or Canada) or (708) 967-5151. Or write Square D Company, 7301 North Caldwell Avenue, Niles, Illinois 60648.

*We Respond.*



**SQUARE D COMPANY**  
INFRARED MEASUREMENT DIVISION  
Dedicated to Growth • Committed to Quality